Post-2012 climate change policy dilemmas: A review of proposals

Kuik, O.J.; Aerts, J.C.J.H.; Berkhout, F.G.H.; Biermann, F.; Bruggink, J.J.C.; Gupta, J.; Tol, R.S.J.

published in
Climate Policy
2008

DOI (link to publisher)
10.3763/cpol.2007.0333

document version
Peer reviewed version

Post-2012 climate change policy dilemmas: A review of proposals

Kuik, O.J., Aerts, J.C.J.H., Berkhout, F.G.H., Biermann, F., Bruggink, J.J.C., Gupta, J., Tol, R.S.J.

Climate Policy, 8(3), 317-336

Published as: Kuik, O., Aerts, J., Berkhout, F., Biermann, F., Bruggink, J., Gupta, J. and Tol, R.S.J., Post 2012 Climate Change Policy Dilemmas: How Do Current Proposals Deal With Them? *Climate Policy*, vol 8, no 3, 2008: 317-336.

Post-2012 Climate Policy Dilemmas:

A Review of Proposals

Abstract

This paper assesses a wide range of alternative proposals for post-2012 international climate policy regimes. We believe that these proposals will serve as a basis for debates about how to configure post-2012 climate policy. The paper characterises and assesses the policy proposals along the lines of five key policy dilemmas. We argue that 1) many proposals have ideas on how to reduce emissions, but fewer have a solution on how to stimulate technical innovation; 2) many proposals formulate climate policy in isolation, while there are fewer proposals that try to mainstream climate policies in other policy areas; 3) many proposals advocate market-based solutions, while fewer realise that there are certain drawbacks to this solution especially at the international level; 4) most proposals have a preference for a UN-based regime, while a more fragmented regime, based on regional and sectoral arrangements may be emerging; and 5) most proposals have ideas about mitigation, but not many have creative ideas on how to integrate mitigation with adaptation.

Keywords: climate change policy, post-2012 negotiations, energy policies.

1. Introduction

At the Climate Change Conference in Montréal in 2005, the Parties to the Framework Convention on Climate Change decided to start a dialogue to exchange experiences and analyse strategic approaches for long-term cooperative action to address climate change.[1)] The Parties did not have to start their dialogue from scratch. In the last few years, policy analysts have tabled a large and diverse number of proposals for a post-2012 climate change regime. A few years ago, (Bodansky, Chou et al. 2004) published a selection of 44 proposals. A number of additional proposals have been published since then. We included eight additional proposals that have been published in the academic literature.[2)] All proposals are listed in Table 1 at the end of this paper. The proposals differ in many ways as they reflect the different preferences and worldviews of their authors. In this paper, we have classified the proposals along five policy choices that are, in our opinion, key to future negotiations on the global climate change regime. These five policy choices refer to questions of incentive structures ("carrots or sticks"), the relationships of climate change policies with other policy areas ("front door or back door"), the relative weight of market-based instruments ("markets or regulations"), multilateralism ("team player or John Wayne"), and finally of the relative weights of mitigation and adaptation ("adapt or mitigate"). These are difficult choices and we will henceforth label them "dilemmas", although responses to any one dilemma may not be mutually exclusive. It is for example possible to use a mix of carrots and sticks as incentive mechanisms. We classified, for each proposal, the responses to the dilemmas on a 5-point scale that includes both extreme responses (e.g., the incentive structure should be "sticks") to in-between responses (e.g., "a mix of carrots and sticks"). The classification was made by one of the au-

thors and is obviously somewhat subjective. But by and large we believe that distributions of the responses to the dilemmas that we show in simple diagrams give a flavour of the direction of thinking in this field. This paper differs from other papers that discuss post-2012 policy options in two respects. Firstly, our approach that focuses on policy dilemmas can be viewed as complementary to, for example, (Philibert and Pershing 2001) (Aldy, Barrett et al. 2003) and (Wittneben, Haxeltine et al. 2005) who assess options against classical assessment criteria such as effectiveness, efficiency, and equity. Secondly, in comparison to the above-mentioned papers we discuss a much wider set of proposals.

Sections 2 to 6 of this paper discuss the five policy dilemmas in greater detail and present the frequency distributions. Section 7 draws conclusions.

2. Carrots or sticks

The first dilemma is about incentive structure: is it better to punish bad behaviour (the stick) or to reward good behaviour (the carrot)? In dealing with an environmental problem such as climate change, economic theory suggests that the emissions that cause the problem be taxed – or that a system of tradable rights or permits to these emissions is established, to bring into the economic system the constraints set by the environmental system. The theory for such an environmental policy is classic and most climate change proposals follow it – emissions taxes and permit systems play a central role. Also, the European Commission, at the forefront of international climate policy, developed its strategy based on energy taxation and an emissions-trading scheme as part of its European Climate Change Programme (ECCP 2000). Direct regulation is another key component of European climate policy, including fuel efficiency standards and a possible ban of candescent lighting.

By contrast, the United States has developed an alternative strategy, the Climate Change Technology Program (CCTP 2002) that emphasises the encouragement of innovation and technological solutions, and promotes international collaboration on their development (Abraham 2004). The focus on technology is founded on the belief that a combination of deep cuts in emissions and sustained economic growth can only be accomplished by a major technological transition in the economy's production processes. At the core of the transition is a shift in the energy supply and demand system. Increasing energy efficiency may be a cost-effective near-term mechanism to reduce emissions, but only to a limited extent. Ultimately, production is impossible without energy, and the United States consider it therefore more productive to search for a transformation of primary energy sources from fossil fuels to CO_2-free energy technologies (Hoffert, Caldeira et al. 2002). Such a transformation requires incentives, which include current subsidies and the promise of future profits, be it through the market, the patent system, or direct regulation. For instance, DuPont's reward for innovation in HFC production was the ban on CFCs.

[Figure 1 around here]

Figure 1 shows that most proposals in our survey promote incentives to reduce emissions, i.e., the "stick". Proposals that promote incentives to reward energy innovation, i.e., the "carrot", typically are from American origins (Schelling 1997; Barrett 2003).

The choice for the carrot (rewarding energy innovation) or the stick (carbon taxes, permits, standards) may represent a difference between an optimist's and a pessimist's view on the economy's capacity to develop and disentangle itself from its dependence on fossil fuels. In the optimist's view the economy only needs a gentle guide to change the direction of technological development – the carrot – while in the

pessimist's view the economy needs a strong economic signal – the stick. Yet the division has more dimensions. The two options also differ in terms of static and dynamic efficiency, in stimulating or hampering economic growth, in distributional effects, in their financial and managerial demands on government, and in negotiation strategy.

From a static perspective, that is, given existing technologies and past investments, greenhouse gas taxes and permits are the most efficient instruments to reach a climate target at the lowest cost. But technologies and investments develop over time, and it is now widely recognised that the dynamic properties of policy instruments are essential for mitigation costs in the longer term. Investments in knowledge and 'green' capital have social pay-offs that may exceed their private pay-offs substantially. Since private investors compare private costs to private benefits, private investments in knowledge and 'green' capital tend to fall short of socially optimal levels. Although a carbon tax, say, would create an incentive to innovate, technology spillovers imply that the private incentives are substantially less than the desired incentives. Furthermore, in a dynamic setting, the costs of climate policies, therefore, depend on whether they discourage or encourage investments (Kverndokk, Rosendahl et al. 2004).

The assessment of climate policy's effect on investments needs careful examination. A carbon or energy tax may hamper investments, but it also generates revenues that can be used to lower other (e.g., corporate profit) taxes with the effect of stimulating investments. Also, a carbon tax may lead to a decrease in investments specifically in the fossil fuel industry, but it may help to shape opportunities and investments for non-CO_2 energy technologies. The total effect on investments is ambiguous. A technology subsidy may stimulate investments in knowledge, but the public expenses need to be paid for by increasing taxes, which may negatively affect overall invest-

ments. Moreover, not all investments may yield equal social benefits. When a government authority subsidises a specific non-CO_2 energy technology, it may err and it may find itself supporting a dead-end technology. Some technologies that now seem promising, may not deliver. Subsidies also have a notoriously bad record concerning their long-term availability, while technology development needs a stable long-term investment climate.

The above arguments represent the neo-classical economic inclination to efficiency, but distributional effects are also important. A carbon or energy tax, or permit system, will lay the initial burden of emissions reductions on the oil producing, processing, and the energy-intensive sectors.[3)] The same is true for direct regulation of these activities. These sectors are influential in the political arena, and when they complain that they loose competitiveness on the world market, this receives attention. Stimulating innovations in energy technologies, by contrast, favours the same industries, as they will be paid to develop new activities. Under such a policy regime, there is no need to compensate the energy and energy-intensive sectors. It should be recognised, however, that such a stimulating innovation policy is only feasible for rich countries: it is beyond the scope of many cash-strapped developing country's governments.

A focus on energy innovation will, if successful, deliver emissions reductions decades from now. It is therefore inherently incompatible with the Kyoto targets that demand immediate action from the developed (Annex B) countries (Claussen 2004). Direct regulation, a carbon tax or permit system are more certain instruments to deliver emission reductions in the short-term. But reducing uncertainty in the achievement of reduction targets comes at a price. When the emissions reduction target is less flexible, uncertainty in the mitigation costs increases. The choice between the carrot and

the stick partly is a choice between accepting uncertainty in environmental effectiveness, versus accepting uncertainty in costs– in both the short term and the long term.[4)]

Finally, a focus on innovation would lend itself to a series of sectoral policies, whereas taxes or permit trade would, in a first-best fashion, be applied economy-wide. A series of sectoral policies may be less efficient, but the cost increase may be limited if competition is stronger within, than between, sectors. When economic activities are concentrated in a few countries only (e.g., car building), effective international cooperation on innovation requires fewer countries than does cooperation on taxes or permits.

3. Front door or back door

Greenhouse gas emissions can be reduced through climate policy (the front door), or as a side benefit of other policies (the back door). These "other policies" can be international, but they are more likely to be domestic – after all, most policies are domestic. The overwhelming majority of the options chooses the front door, with a few additionally calling for technological change and sustainable development (Figure 2). This is no surprise, as we studied only *climate* policy proposals. It is an open question, however, whether greenhouse gas emission reduction is best achieved by an explicit climate policy or by other means. One area of policy making that stands out with regard to its linkages with the climate change issue concerns development and trade policies. Flexible instruments such as the CDM are actually devised to link climate change and development policies explicitly. On the other hand, development and trade policies may also hamper the feasibility of international climate change policies. Unilateral climate change policies in industrial countries will eventually lead to carbon leakages when investment decisions of energy-intensive companies are af-

fected. Reversely, preventing such leakages by CO_2-related border taxes may adversely affect development goals in emerging economies.

[Figure 2 around here]

Purists argue that a policy that aims directly at the problem is always superior to indirect policies. Unfortunately, not many countries have effective greenhouse gas reduction policies. Many countries do, however, have mature and effective policies on energy, air quality, technology, transport, and security – each of which could be instrumental in reducing greenhouse gas emissions. Moreover, many adaptation measures could also be implemented in the context of other policies (e.g., spatial planning, water management), serving multiple objectives.

Policies to improve energy efficiency have been successful in many countries. Although such policies are domestic, their impacts may be wider, through diffusion of technology, through the second-hand market in machinery, or because manufacturers choose to work to the strictest standard (e.g., the USEPA Energy Star programme). Many governments – in industrialised as well as (some) developing countries – support technological progress on the energy supply side, improving existing sources and developing new ones. This is crucially important for climate policy. At some point in this century, the world will run out of conventional oil and gas. This will imply a drastic overhaul of the energy sector. If the preferred successor to conventional oil and gas would be CO_2-free (solar, nuclear, biomass, clean coal), this would alleviate further pressure on the climate system.

Recent geopolitical developments and continuing tensions on world oil markets have pushed the energy security issue higher on the political agenda. Moreover, while in the past energy security used to be primarily an OECD issue (witness the rise of the International Energy Agency), it is now a truly global concern– although, by its very

nature, energy security is still primarily seen as a national issue, even in the EU. Fast growing Asian nations tend to be even more vulnerable than OECD nations to oil supply disruptions. The present dichotomy between nations preferring emission market agreements (EU, Russia) and those preferring technology development agreements (United States, China) can, according to some authors, at least partially be explained by their long-term energy security objectives and related domestic resource positions (Huntington and Brown 2004; Kemfert 2004).

The perception of energy security risks has changed considerably since the issue became a prominent energy policy objective in the wake of the oil crises of the 1970's. At that time, the focus was primarily on the short-term consequences of high prices and the macroeconomic impacts with a corresponding emphasis on measures related to strategic stockpiling and macroeconomic policy (Bohi and Toman 1996). The emphasis has now shifted to long-term implications and broader areas of concern including supply disruptions unrelated to oil markets, in particular in response to power system reliability problems caused by liberalisation policies (Blyth and Lefevre 2004). In addition, the threat of terrorism has increased worries about physical disruptions caused by infrastructural vulnerabilities related to shipping routes, refineries, pipelines and power networks (Farrell, Zerriffi et al. 2004). There is also concern about political instability in key supplier countries. When evaluating the potential of addressing climate change and energy security challenges simultaneously, it is important to be aware of this widening perception. Energy security in a narrow sense has traditionally been viewed purely as a problem of energy resource diversification. Energy security in a broader sense however includes other aspects of energy system design related to choices between distributed and centralised systems in general (Lovins and Lovins 1982). Properties of system resilience in addition to properties of fuel and technology diversity are important in this respect.

Few studies on the future architecture of post-Kyoto policy regimes explicitly address climate change and energy security. Yet, synergy with domestic energy security agendas could improve the political feasibility of international climate change measures substantially. (Blyth and Lefevre 2004) develop a framework for measuring possible synergies quantitatively by comparing measures of climate change performance (level of CO_2 emissions) and measures of energy security performance (fuel supply diversity and back-up power requirements) for various energy scenarios. (Kessels and Bakker 2005) evaluate how energy security concerns could possibly be integrated in existing proposals for post-Kyoto policy regimes. They conclude that existing proposals based on top-down target setting and market instruments offer limited opportunities. In target setting one could leave more room for national security related constraints. In emission markets one could privilege those who implement domestic mitigation measures in one way or another above those who settle their CO_2 budget on the international market. The main conclusion of (Kessels and Bakker 2005) is that bottom-up, technology-oriented types of agreement offer more scope for energy security concerns than top-down, market-oriented approaches.

Development policy is another option to do climate policy through the back door. Again, this is not clear-cut. While energy efficiency clearly improves with economic growth, it may be overwhelmed by additional demand for energy. A Kuznets curve for carbon dioxide emissions has not been established (Lindmark 2004; Galeotti, Lanza et al. 2006). In fact, the relationship between economic activity and energy use is complex and mixed (Lee and Chang 2007). One can therefore not a priori say that development policy would help reduce emissions. The verdict on reallocation of development aid to emission abatement (Michaelowa and Michaelowa 2007) is inconclusive too. The same is true for liberalisation of international markets for goods, services and capital. This would stimulate economic growth, which may be good or bad.

It would accelerate the diffusion of energy-efficient technology, which is good for climate change, but it would also increase the demand for travel and transport, which is bad for climate change. The relationship between development and adaptation is clearer. In general, richer economies are less vulnerable to climate change (Tol 2002). This aggregate relationship does not hold, however, for every aspect. Some climate change impacts would fall rapidly with economic growth – infectious diseases are a good example (Tol, Ebi et al. 2007) – while other impacts would increase – for instance, the value of ecosystem impacts (Tol 2002). So, while development policy may help to reduce greenhouse gas emissions as well as vulnerability to climate change, it is clear that this is true only for a judicious choice of possible development policies.

Solving the climate problem on the back of other policies would theoretically not be the first-best approach, but it might well be effective enough if robust policies are in place. Adjusting a policy to serve multiple goals may, on the one hand, increase its costs – and sometimes excessively so[5)] – but, on the other hand, may also benefit from synergies (and avoid the shifting of externalities) between different policy areas. In a number of the policy areas mentioned above, the climate-friendly alternative might be the preferred one anyway, both with respect to mitigation and adaptation.

A precondition for a successful 'backdoor' policy is the existence of robust policies in relevant, adjacent policy areas. If such robust policies are not in place, as in some developing countries, obviously not much can be expected from such a policy. Whether or not backdoor policies may be an effective option would therefore need careful consideration on a case-by-case basis. Examples of post-2012 proposals that emphasize "backdoor" approaches are, for example, (Athanasiou and Baer 2006; Winkler, Brouns et al. 2006).

4. Markets or regulation

Another division in climate change policies is between market solutions and direct regulations. At one end of the spectrum, many economists have repeatedly emphasised that we only need to get the prices right: give greenhouse gas emissions their price and leave it to the market to find solutions. In this view, the climate change problem is considered as a missing market; and the problem is solved once we create this market by allocating property rights. The invisible hand of the market will do the rest. At the other end of the spectrum, there is the view – often expressed by engineers and governance specialists – that price signals are insufficient to change the environmental performance of firms and households. In this view, there are many technical possibilities to lower energy use and the carbon intensity of energy supply at zero or even negative costs, but the market – in search for short-run profits – systematically fails to implement these 'win-win' solutions. Hence, advocates of the regulatory view argue that governments should enforce standards for housing, transport, and industries' energy efficiency, and for the carbon intensity of energy supply.

Economists used to fiercely oppose the direct regulation view as an inefficient instrument, but many have come to recognise that direct regulation often may not work that badly after all. The opposition comes from the economic assertion that there can be no negative-cost fixes to climate change, as competition drives all economic actors to search actively for any profit-enhancing opportunities. In this view, engineering fixes are considered typical results of know-it-alls who overlook many real but hard-to-measure costs such as for extra management. Yet, economists have also started to realise that there may be inefficiencies in the economy as a whole, not just at the micro level, that might be overcome through direct regulation. As innovators typically do not succeed to appropriate the full social value of their innovations, they spend

less on research than desirable. Using market instruments, the public authority may provide subsidies for research, but this may create its own diversion, as 'research' is an accounting construct that enterprises can exaggerate to reduce taxes. Alternatively, the government may announce that it will demand an entire sector to comply with the most energy efficient technology available. The patent value for any new technology improving on energy efficiency will increase substantially if all firms will have to apply the technology. In the end, the direct regulation may boost innovation better than the research subsidy does.

A second benefit of direct regulation can lie in its trickle-down effect on other sectors and countries. When manufacturers are forced to comply with an emissions directive on a sufficiently large market, e.g., Germany or California, it may be more profitable for them to apply the same technology to produce for all markets, instead of applying different technologies to produce for different markets. In economic terms, an agent controlling specific features of a large market can exert substantial market power that affects other markets as well. This could also be very significant for that group of developing countries whose markets function so poorly that it would hamper the successful implementation of market-based instruments anyway.

Within the domain of market versus regulation, the climate proposals are distributed pretty evenly (Figure 3). Most remarkably, there is a substantial group of climate policy proposals that use a hybrid approach with elements of both regulation and markets. Many proposals specify regulation on a broader level, not per product but per sector or country.

[Figure 3 around here]

A typical example is the system of portfolio standard rating, where industries are bound to limit their emissions per output or per value added, but are also allowed to

buy extra emission permits or sell a surplus of emission permits in an emissions trading scheme (Benedick 2001). Hybrid schemes provide firms the flexibility to reduce less when necessary or more when possible. Inclusion of Joint Implementation and Clean Development Mechanism projects in an emission-trading scheme would further integrate market instruments and regulation.

Development of hybrid mechanisms needs careful design. They may combine the advantages of market and regulation, but they may also multiply the disadvantages. The flexibility of a market may avoid individual firms facing unnecessarily high costs, while the overall regulation on a sector or country level ensures effectiveness. But it is also possible that market flexibility causes a sector not to develop new low-CO_2 technologies, while the trading scheme leads to high monitoring and transaction costs shifted to the public sector.

5. Team player or John Wayne

The proposals for a post-2012 climate policy architecture can be distinguished according to the degree to which they support multilateral solutions as opposed to small-party agreements, or pure unilateralism.

On the one side of the spectrum are authors who continue to support the multilateral approach enshrined in the Kyoto Protocol and earlier in the UNFCCC, that is, the attempt of reaching a compromise that mediates the interests of all nations. On the other side of the spectrum are those who seek to complement, or to replace, the Kyoto regime through small-party regimes, plurilateral and bilateral agreements or unilateral measures outside the Kyoto Regime (Biermann 2005; Asselt 2007). Most proposals from developing country authors support multilateralism, while most from the United

States lean towards unilaterally initiated agreements in line with trends in other issue areas (Newman, Thakur et al. 2006). Europeans are divided on the issue.

[Figure 4 around here]

Unilateralists, mostly of United States' origin, have suggested alternative, regional agreements with like-minded countries, for example of the United States with states in Latin America or with China and possibly other key developing countries (Stewart and Wiener 2003). (Bodansky 2002), for instance, argues for an 'institutional hedging strategy' with the United States becoming the creator of 'a more diversified, robust portfolio of international climate change policies in the long term'. For Bodansky, such an approach would allow negotiation with only the more 'moderate' developing countries, while disabling 'the hard-line developing countries […] to prevent more moderate developing states from joining' (Bodansky 2002). Secondly, unilateralists are often less than enthusiastic about the role of the United Nations in climate governance, and see the United Nations' system as part of the problem rather than part of the solution. Negotiations under the United Nations umbrella are seen as being too 'large, unwieldy, ideologically laden' to oversee the 'simple tasks of the kind required [under the climate convention]' (Bodansky 2002). Thirdly, unilateralists have proposed joint action through issue-specific agreements (cf., the analysis in (Asselt, Biermann et al. 2004)). These could include targets for specific sectors, e.g., energy-efficiency standards for the global automobile industry that would need to bring together only the most important car-producing countries (Barrett 2002); specific policies, such as energy taxes; agreements and targets for co-operation in scientific research and technology development (Benedick 2001; Barrett 2002; Aldy, Barrett et al. 2003), including on carbon sequestration, renewables, geological storage and energy conservation; targets on technology transfer and capacity building; and specific

measures to increase co-operation regarding adaptation. Finally, unilateralists are often at the forefront of promoting public-private and private-private partnerships at the global level, notably in supporting the so-called 'type-2 outcomes' of the 2002 World Summit on Sustainable Development (as opposed to type-1 traditional inter-governmental agreements) (cf., for an overview (Hale and Mauzerall 2004)).

Not all of these proposals and approaches deny a role for, or the continuing existence of, a multilateral framework. In theory, issue-specific or regional agreements could be reached outside the climate convention, but also within its framework or even as part of an amended Kyoto Protocol. Many proposals also suggest a role for the climate convention as facilitator of other approaches Sugiyama, 2005 #35} or envisage a re-turn to this framework over time (e.g.,(Bodansky 2002; Bodansky 2002; Stewart and Wiener 2003)), especially since there are a number of recent indicators that signal such a return (Gupta 2007). Yet in sum, the thrust of most unilateralists is to find new, often also more flexible ways that include fewer nations for joint action than a fully multilateral approach requires.

Multilateralists, on the other hand, continue to support the universal approach in cli-mate policy as in other policy domains. Multilateralism allows for side-payments across negotiation clusters within a policy domain and across different policies; and it minimises the risk for smaller nations to be coerced into bilateral agreements with powerful nations that might offer them suboptimal negotiation outcomes. In particular for the many smaller and medium-sized developing countries, unity is strength, and multilateralism its guarantee (Gupta 2006).

Unilateralism and multilateralism can coexist only to a limited extent. Decision-makers need to make choices. On the one hand, sectoral, selective or non-legally binding agreements bear the promise of quicker solutions since negotiations are easier

given the smaller number of actors and interests at the table and the non-binding nature of the outcome. The advantage of fewer parties has been emphasised by some strands of negotiation theory, which posit stronger commitments and faster progress the fewer (like-minded) parties participate in a given negotiation.

On the other hand, a selective agreement will produce a solution that applies only to the few participating countries and fits the interests only of those countries, and it is not guaranteed that other countries will later join. While the problem of free riders was effectively addressed in the Montreal Protocol by limiting the trade opportunities of those outside the system, this is not the case in the climate regime. Moreover, a quick success in negotiating sectoral agreements might run counter to long-term success, when important structural regime elements have not sufficiently been resolved. And finally, smaller agreements only with few 'like-minded countries' will decrease the opportunity for creating package deals that will minimise the overall policy acceptance and effectiveness (Sugiyama and Sinton 2005; Tangen and Hasselknippe 2005). At the same time, such agreements will tend to completely marginalise the smaller countries who are especially vulnerable to climate change (Gupta 2007).

Regional agreements of a few like-minded players, in the hope that others will later follow, may not bring the long-term trust and regime stability that is needed in the climate domain. The post-2012 climate governance system requires institutional mechanisms that are trustworthy, stable, provide for cross-issue bargains, and include all nations. Some would argue that this can only be offered by a global framework agreement that sets out the constitutional rules of climate governance in the 21st century, and detailed agreements on subquestions that are negotiated within the larger, stable, normative system that sustains the 'grand bargain' (Müller 2003; Biermann 2005). Furthermore, some writers also argue that "Washington has yet to understand

that nothing is more dangerous for a 'hyperpower' than the temptation of unilateralism" (Hoffmann 2000) and or that globalisation itself might dilute the power of the unilateralists (Nye 2000). Ironically, it might be the multiplication of climate change litigation against U.S. companies and agencies, both within the United States and outside, that might convince the U.S. government of the need for multilateral solutions on the issue, or perhaps of unilateral emissions reduction. Current litigation efforts, if successful, could also put the large developing countries on notice that if they continue to emit without some abatement effort, they too could be held liable in international and/or domestic courts (Gupta 2007), as past emissions can perhaps be excused because of ignorance about their consequences, but future emissions cannot (Tol and Verheyen 2004). The prospect of liability may, of course, also reduce the political incentives for large developing countries, such as India and China, to adopt a constructive attitude in climate negotiations and climate research.

6. Adapt or mitigate

Most climate policies are traditionally targeted at mitigating greenhouse gases, with adaptation to climate variability and change playing only a minor role. Most policy options propose a continuation of this strategy as only 6 out of 44 policy proposals have identified adaptation as a serious policy issue (Figure 5). These proposals are usually the ones that pay most attention to North-South issues (Müller 2002; Ott, Winkler et al. 2004; BASIC 2006).

[Figure 5 around here]

Historically, the impacts and adaptation issues were disconnected from the emissions issue to reduce the likelihood of discussions on liability and compensation (Gupta 1997). There are many reasons as to why adaptation is not high on the policy agenda, although it is increasingly recognised that immediate adaptation action is required in

several economic sectors (e.g., flood protection, drought management, heat waves and health) (EEA 2004). Apart from the need to avoid liability discussions, there are also substantive arguments such as that adaptation is best arranged at local to provincial levels (Tol 2005), because of the uncertainty on the magnitude of future climate variability and its impact at smaller scales (regional and local) and the specific cultural and institutional contexts within which such adaptation needs to take place. Hence, it is difficult to develop standard, across the board adaptation (on top of current policies) to adapt to future climate variability and change (Burton, Huq et al. 2002). This uncertainty leads to the inevitable question of how much extra adaptation investments are required? Which investments are robust to a variety of future climate scenarios? And finally, how much adaptation is needed given a certain greenhouse gas level achieved by mitigation policies?

Other policy obstacles for developing adaptation policies are a lack of both policy and legislative frameworks, particularly at the local and regional levels, and insufficient coordination between policies targeted at individual economic sectors. It also appears that long-term developments such as climate change (>10 year) are seldom addressed in current national policies.

Nonetheless, some adaptation policies are being developed and implemented. For example, adaptation policies are mainstreamed in ongoing sectoral policies – most notably in countries with a long tradition in developing water management adaptations to extreme weather events (Aerts and Droogers 2004). Furthermore, risk management and disaster preparedness policies are gradually adopting climate change as an additional risk that should be addressed in financial arrangements and (re-) insurance (Berz 1999). Some adaptation initiatives are being developed such as research programmes on climate change impacts. But with the exception of the Millennium De-

velopment Goals that do explicitly address adaptation as an important process to prepare for and cope with a changing climate, integration of climate change considerations in key policies, such as policies on biodiversity, agriculture, international trade, fresh water resources and coastal zone management, has not yet taken place to a large extent.

Recent publications by insurance companies and other financial institutes support the argument of having a combined mitigation and adaptation policy. For example, (Munich_Re 2005) states that weather-related disasters cause two-thirds of direct economic losses worldwide and cause three-quarters of life fatalities, with 80 percent of these fatalities occurring in the poorest countries. Global direct losses from so-called great floods have increased by a factor of 10 between the 1960s and the 1990s, but this increase is generally attributed to increasing habitation of vulnerable areas and wealth increases rather than to climate change (e.g.,(Changnon 2003)). Finally more controversial adaptation policies are related to geo engineering options that aim at directly influencing atmospheric processes (Weitzman 2007).

The above facts reveal that, apart from climate change, extreme weather events already have a profound effect on natural and economic resources. It is therefore recommended that new adaptation policies should be part of an integrated mitigation-adaptation policy, in particular those that relate to disaster risk reduction (e.g., (Hoff, Warner et al. 2005)). As adaptation measures have to be implemented at the regional and local scale, new policies should be specifically targeted at these scales. Both cross-scale communication and cross-sectoral participation is a prerequisite for a successfully implementation of new adaptation policies. The financing of adaptation and disaster risk management, however, remains a critical issue in climate policy, as cur-

rent funds for adaptation under the UNFCCC are limited (Bouwer and Vellinga 2005).

7. Conclusions

A new period of intense debate about the future of international climate policy has begun. With the entry into force of the Kyoto Protocol in February 2005, policy makers have started to look towards the end of the first commitment period in 2012 to assess whether national emissions reductions targets will be met. They have also started to look at what will happen post-2012. One option would be to build on Kyoto, establish a second commitment period and employ the same approaches and measures established since negotiation of the UNFCCC in 1992; and this option is presently being pursued with the UNFCCC, especially as all Parties to the Convention, including the United States, are bound by international law to not undertake policies that go against the spirit of this agreement. Although the United States has initiated a number of agreements with other countries on climate change related issues, the latest of which is one with Australia, South Korea, India and China, it continues to maintain in its policy documents that these are in line with the US commitments under the UNFCCC (Gupta 2007). However, the actual impact of these initiatives is difficult to predict and may challenge key notions of the Convention. In recognition of these questions, analysts in Europe, the United States, Japan and some developing countries have developed a series of alternative proposals over the past decade and more. Now is a good time to review these options: to assess whether they contain frameworks or ideas that could play a role in securing effective global climate management.

This policy assessment characterised a wide range of options according to some fundamental dilemmas in climate policy. Our main conclusions in characterising policy options are:

- There are many ideas about how to tackle global climate problems by improving cost-efficient emission reduction from a static perspective (sticks), but there are fewer ideas about how to tackle the problem of stimulating global technological innovation from a dynamic perspective (carrots). Creating an appropriate architecture for a balanced approach combining the aims of short-term static efficiency and long-term dynamic efficiency is a key post-2012 requirement.

- Many proposals for formulating climate policy in isolation from other policies (front door) exist, but there are fewer ideas about how to mainstream climate policy in other, less controversial policy arenas in a coherent and transparent way. Creating effective issue-linkages (back door) between the climate policy arena and other policy arenas has been and will continue to be a key post-2012 requirement. Although making such issue-linkages may sound relatively simple, the history of the negotiations in other arenas, the different power politics, and possibly different parties engaged in these negotiations, imply that issue-linkage that may sound simple to start with may be very difficult to achieve.

- It is difficult to develop new options that rely exclusively on either market forces or regulatory measures - markets and regulations must be viewed as mutually dependent and reinforcing, rather than alternative courses of action. While there is a great appetite among some governments for greater focus on incentivising through market-based instruments, the drawback is often that they do not provide the same assurance that environmental targets can verifiably be met on time.

- Choosing between a multilateral UN-based order and a more fragmented set of arrangements depends on the worldviews that drive politics in different countries. Countries that have been involved in international wars on their own territories and are relatively weak in the international arena generally seek a rule-based multilateral order, whereas countries that see themselves as having growing international power may prefer to guide global politics rather than democratically participate in it. Although the existing multilateral system is under pressure, we expect that there will be stiff competition between the two approaches, and often collaboration. The key is to find ways to accommodate both approaches.

- Many ideas exist for tackling greenhouse gas mitigation, but there are few ideas about tackling problems of adaptation, or for integrating mitigation and adaptation. It seems clear that at a broad strategic level there is a potential trade-off between mitigation and adaptation – more of one implies less of the other – but this is seldom taken up in climate policy proposals. This may be because national interests with respect to mitigation and adaptation differ – some countries being more sensitive to the need for adaptation than others – and because mitigation actions in one country cannot be easily traded for adaptation actions in another. There are clear cases when mitigation and adaptation should be integrated – as with rising demand for air conditioning in response to higher summer temperatures. But this need not always be the case. In practice, there is little integration in the proposals. Perhaps this is also because mitigation policies are inherently more 'front door', while adaptation policies are more 'back door' (such as disaster relief and prevention).

The art of building an effective and inclusive post-2012 climate regime, which provides dynamic incentives for technological innovation and behaviour change and spreads burdens fairly, is an enormous challenge. We have classified the proposals according to five policy dilemmas which we believe are key to future negotiations. Clearly, these dilemmas will need to be dealt with by national and international negotiators. Our review also points to the need to anchor climate policy more firmly within economic, social and environmental policies, and to avoid regarding it as a special and isolated case.

Acknowledgements

Notes

1) Decision -/CP.11. Montreal, 2005.
2) In our selection of proposals we did not include “official” documents, such as for example, the declaration of the G8 Summit of Gleaneagles (Grubb 2005). Although important as they may be in the political process, by their nature they are not very explicit about the choices and confine themselves to underlining some broad principles and calling for “dialogue”.
3) In the short term, this burden is largely passed on to consumers.
4) In the short term, the choice between taxes and tradable permits revolves around the trade-off between target and cost uncertainty.

5) Compare the famous proposition of Tinbergen that in economic policy the number of policy instruments should at least be as large as the number of policy objectives ((Tinbergen 1952)).

Table 1 Proposals for post-2012 climate change policy regimes

Proposed regime	Source	Characteristics of the proposed regime[a]				
		I	II	III	IV	V
1.2 Kyoto	*UN*	*5*	*5*	*3*	*5*	*5*
Ability to pay	(Jacoby, Schmalensee et al. 1999)	5	5	5	5	5
Agreed domestic carbon taxes	(Cooper 1998)	5	5	5	5	5
Bottom-Up	(Reinstein 2004)	4	5	3	1	5
Brazilian proposal	(Brazil 1997)	5	5	n.a	5	5
Broad but shallow beginning	(Schmalensee 1996)	5	5	n.a	1	5
Climate Marshall plan	(Schelling 1997; Schelling 2002)	1	5	n.a	1	5
Contraction and convergence	(Meyer 1998)	5	5	n.a	5	5
Converging markets	(Tangen and Hasselknippe 2005)	5	5	5	1	5
Domestic hybrid trading schemes	(McKibbin and Wilcoxen 2002)	5	5	5	5	5
Dual intensity targets	(Kim and Baumert 2002)	5	5	5	3	5
Dual track	(Kameyama 2003)	5	5	3	3	5
Equal mitigation costs	(Babiker and Eckaus 2000)	5	5	3	n.a	5
Expanded common but differentiated	(Gupta and Bhandari 1999)	5	5	n.a	5	5
Further differentiation	(SEPA 2002)	5	5	3	5	5
Global framework	(CAN 2003)	5	5	n.a	5	4
Global preference score	(Müller 2001)	5	5	n.a	5	5
Global Triptych	(Groenenberg, Blok et al. 2004)	5	5	2	5	5
Graduation and deepening	(Michaelowa, Butzengeiger et al. 2005)	5	5	5	5	4
Growth baseline	(Hargrave, Helme et al. 1998)	5	5	n.a	5	5
Harmonized carbon taxes	(Nordhaus 2005)	5	5	5	5	5
Human development goals	(Pan 2005)	5	5	n.a	1	5
Hybrid emissions trading	(Aldy, Orszag et al. 2001)	4	5	5	3	5
Insurance for adaptation	(Jaeger 2003)	5	5	4	1	3
International agreements on energy efficiency	(Ninomiya 2003)	4	5	1	5	5
Keep it simple, stupid	(Gupta 2003)	5	5	3	5	5
Long-term permit programme	(Peck and Teisberg 2003)	5	5	5	5	5
Multi-dimensional structure	(METI 2003)	3	5	2	2	5
Multi-sector convergence	(Sijm, Jansen et al. 2001)	5	5	2	5	5
Multistage	(Höhne, Phylipsen et al. 2005)	5	5	n.a	4	5
Orchestra of treaties	(Sugiyama and Sinton 2005)	3	5	3	2	5
Parallel climate policy	(Stewart and Wiener 2003)	5	5	5	1	5
Per capita allocation	(Agarwal 2001)	5	5	2	5	5

Portfolio approach	(Benedick 2001)	2	4	3	2	5
Purchase of a global public good	(Bradford 2004)	5	5	5	1	5
Safety valve	(Pizer 2005)	5	5	5	2	5
Safety value with buyer liability	(Victor 2003)	3	5	5	2	5
Safe landing in emissions growth	(Blanchard 2002)	5	5	5	5	5
South-North dialogue	(Ott, Winkler et al. 2004)	5	5	n.a	5	4
Sustainable development PAM	(Winkler, Brouns et al. 2006)	3	3	3	3	5
Technology backstop protocol	(Edmonds and Wise 1998)	5	5	4	5	5
Technology-centred approach	(Barrett 2003)	2	4	5	1	4
Three-part policy architecture	(Stavins 2004)	5	5	5	5	5
Two-part commitments for ind. countries	(Bodansky, Chou et al. 2004)	5	5	n.a	5	5
UNFCCC Impact response instrument	(Müller 2002)	5	5	n.a	5	1
Broadening the climate regime	(Torvanger, Bang et al. 2005)	5	5	n.a	5	3
Common but differentiated convergence	(Höhne, Elzen et al. 2006)	5	5	n.a	5	5
Sao Paulo proposal	(BASIC 2006)	4	5	n.a	5	4
Global climate certificate system	(Wicke 2005)	5	4	n.a	5	5
Vattenfall proposal	(Vattenfall 2006)	5	5	5	3	5
Greenhouse development rights	(Athanasiou and Baer 2006)	5	3	1	5	5
Sector-based approach	(Schmidt, Helme et al. 2006)	3	4	1	1	5
Action targets	(Baumert and Goldberg 2006)	5	3	n.a	5	5

[a)] explanation of Roman and Arabic numerals:
I : carrot (1), more carrot than stick (2), a bit of both (3), more stick than carrot (4), stick (5)
II : back door (1), more back than front (2), a bit of both (3), more front than back (4), front door (5)
III : regulation (1), more regulation than market (2), a bit of both (3), more market than regulation (4), market (5)
IV : John Wayne (1), more John than team (2), a bit of both (3), more team than John (4), team player (5)
V : adaptation (1), more adaptation than mitigation (2), a bit of both (3), more mitigation than adaptation (4), mitigation (5).

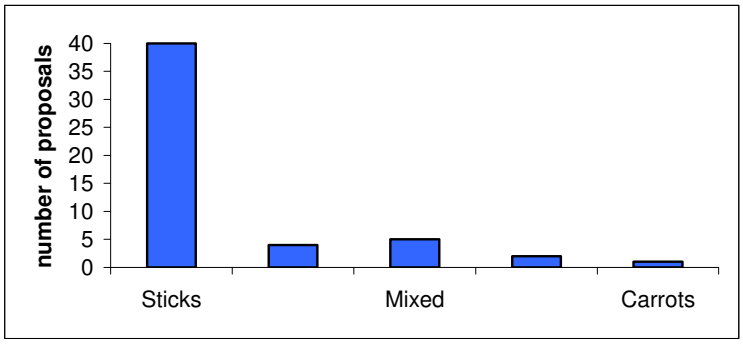

Figure 1. The bulk of the current proposals for a climate regime emphasise emission reduction (sticks) over innovation (carrots), including the Kyoto Protocol.

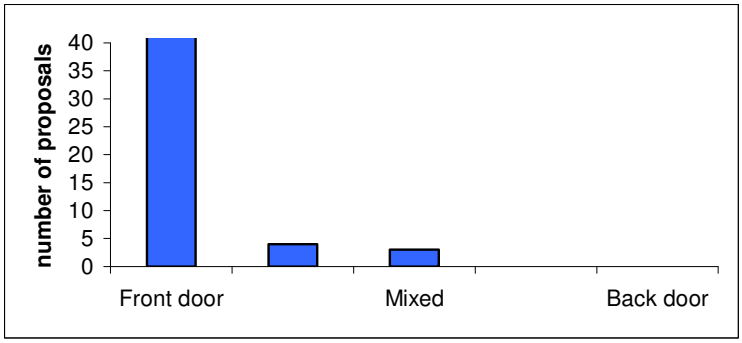

Figure 2. The bulk of the current proposals emphasise front door over back door, as does the Kyoto Protocol.

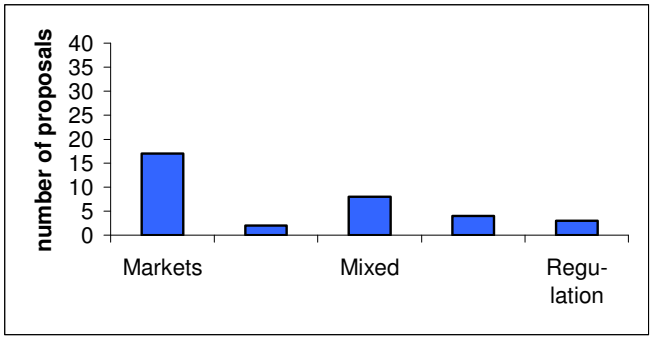

Figure 3. Most of the current proposals for a climate regime emphasise the market mechanism (markets), although mixed regimes (mixed), as in the Kyoto Protocol, are also popular.

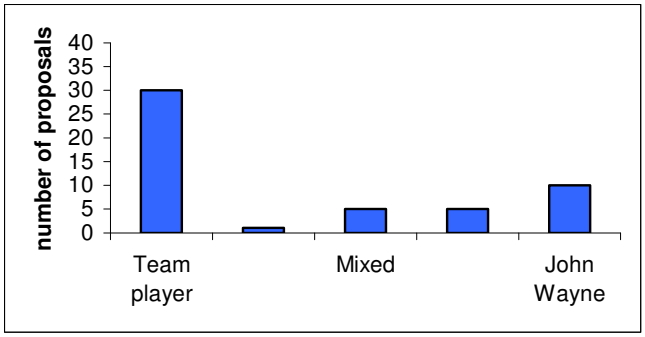

Figure 4. The current proposals are polarised between a regime of strong international law (team player) – including the Kyoto Protocol – and a regime of unilateral measures and small-party approaches (John Wayne).

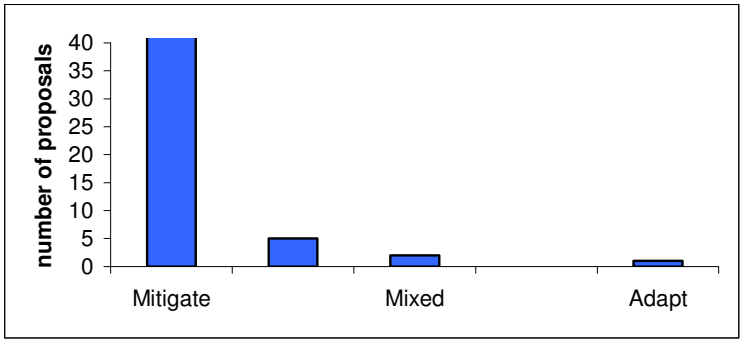

Figure 5. Most current proposals emphasise mitigation over adaptation, including the Kyoto Protocol.

References

Abraham, S. (2004). "The Bush Administation's Approach to Climate Change." Science **305**: 616-617.

Aerts, J. and P. Droogers, Eds. (2004). Climate Change in Contrasting River Basins: Adaptation Stategies for Water, Food and Environment. Wallingford, Oxfordshire, CABI Books.

Agarwal, A. (2001). Making the Kyoto Protocol Work: Ecological and Economic Effectiveness, and Equity in the Climate Regime. New Delhi, India, Centre for Science and Environment.

Aldy, J. E., S. Barrett, et al. (2003). "Thirteen plus one: a comparison of global climate policy architectures." Climate Policy **3**(4): 373-397.

Aldy, J. E., P. R. Orszag, et al. (2001). Climate Change: An Agenda for Global Collective Action, Prepared for the conference on "The Timing of Climate Change Policies" Pew Center on Global Climate Change, October 2001.

Asselt, H. v. (2007). "From UN-ity to Diversity? The UNFCCC, the Asia-Pacific Partnership, and the Future of International Law on Climate Change." Carbon and Climate Law Review **1**(1): 17-28.

Asselt, H. v., F. Biermann, et al. (2004). Interlinkages of Global Climate Governance. Beyond Climate: Options for Broadening Climate Policy. M. T. J. a. C. Kok, H.C. de. Bilthoven, RIVM. **Report 500019001/2004:** 221-246.

Athanasiou, T. and P. Baer (2006). Greenhouse Development Rights, EcoEquity and Christian Aid.

Babiker, M. and R. S. Eckaus (2000). Rethinking the Kyoto Emissions Targets. Cambidge, MA, USA, MIT Joint Program on the Science and Policy of Global Change.

Barrett, S. (2002). Towards a Better Climate Treaty. Venice, Italy, Fondazione Eni Enrico Mattei,.

Barrett, S. (2003). Environment and statecraft : the strategy of environmental treaty-making. Oxford, UK, Oxford University Press.

BASIC (2006). The Sao Paulo proposal for an agreement on future international climate policy. Sao Paulo, Instituto de Estudos Avancados da Universidade de Sao Paulo

Baumert, K. A. and D. M. Goldberg (2006). "Action targets: a new approach to international greenhouse gas controls " Climate Policy **5**(6): 567-581.

Benedick, R. (2001). "Striking a New Deal on Climate Change." Issues in Science and Technology Online **18**(1).

Berz, G. (1999). "Catastrophes and Climate Change: Concerns and Possible Countermeasures of the Insurance Industry." Mitigation and Adaptation Strategies for Global Change **4**(3/4): 283-293.

Biermann, F. (2005). "Between the USA and the South: strategic choices for European climate policy." Climate Policy **5**(3): 273-290.

Blanchard, O. (2002). Scenarios for Differentiating Commitments: A Quantitative Analysis. Building on the Kyoto Protocol: Options for Protecting the Climate. K. A. Baumert, O. Blanchard, S. Llosa and J. F. Perkaus. Washington, D.C., USA, World Resources Institute**:** 204-222.

Blyth, W. and N. Lefevre (2004). Energy Security and Climate Change Policy Interaction: An Assessment Framework. Paris, International Energy Agency.

Bodansky, D. (2002). Linking U.S. and International Climate Change Strategies. Washington, DC, Pew Center on Global Climate Change.

Bodansky, D. (2002). U.S. Climate Policy After Kyoto: Elements for Success. Washington, DC, Carnegie Endowment for International Peace.

Bodansky, D., S. Chou, et al. (2004). International Climate Efforts Beyond 2012: A Survey of Approaches. Arlington, VA, USA, Pew Center on Global Climate Change.

Bohi, D. R. and M. A. Toman (1996). The Economics of Energy Security. Dordrecht, Kluwer.

Bouwer, L. M. and P. Vellinga (2005). "Some Rationales for Risk Sharing and Financing Adaptation " Water Science and Technology **51**(5): 89-95.

Bradford, D. F. (2004). Improving on Kyoto: Greenhouse Gas Control as the Purchase of a Global Public Good. Princeton, NJ, USA, Princeton University Center for Economic Policy Studies.

Brazil (1997). Proposed Elements of a Protocol to the United Nations Framework Convention on Climate Change, Presented by Brazil, in Response to the Berlin Mandate.

Burton, I., S. Huq, et al. (2002). "From Impact Assessment to Adaptation Policy." Climate Policy **2**(2/3): 145-159.

CAN (2003). A Viable Global Framework for Preventing Dangerous Climate Change, Climate Action Network (CAN).

CCTP. (2002). "About the U.S. Climate Change Technology Program." Retrieved 10-09-2007, from http://www.climatetechnology.gov/about/index.htm.

Changnon, S. A. (2003). "Shifting Economic Impacts from Weather Extremes in the United States: A Result of Societal Changes, Not Global Warming." Natural Hazards **29**(2): 273-290.

Claussen, E. (2004). "An Effective Approach to Climate Change." Science **306**: 816.

Cooper, R. N. (1998). "Toward a real global warming treaty." Foreign Affairs **77**(2): 66-79.

ECCP. (2000). "European Climate Change Programme." Retrieved 10-09-2007, from http://ec.europa.eu/environment/climat/eccp.htm.

Edmonds, J. and M. Wise (1998). Building Backstop Technologies and Policies to Implement the Framework Convention on Climate Change. Washington, D.C., USA, Pacific Northwest National Laboratory.

EEA (2004). Impacts of Europe's Changing Climate. Copenhagen, European Environment Agency.

Farrell, A. E., H. Zerriffi, et al. (2004). "Energy Infrastructure and Security." Annual Review of Environment and Resources **29**: 421-469.

Galeotti, M., A. Lanza, et al. (2006). "Reassessing the environmental Kuznets curve for CO2 emissions: A robustness exercise." Ecological Economics **57**(1): 152-163.

Groenenberg, H., K. Blok, et al. (2004). "Global Triptych: a bottom-up approach for the differentiation of commitments under the Climate Convention." Climate Policy **4**(2): 153-175.

Grubb, M. (2005). "The G8 Gleneagles Summit, 6–8 July 2005." Climate Policy **5**(2): 233-235.

Gupta, J. (1997). The Climate Change Convention and Developing Countries - From Conflict to Consensus?,. Dordrecht, Kluwer Academic Publishers.

Gupta, J. (2003). Engaging developing countries in climate change: (KISS and make up!). Climate policy for the 21th century: meeting the long-term challenge of global warming. D. Michel. Washington, DC, Center for Transatlantic Relations.

Gupta, J. (2006). Environmental Multilateralism: Under Challenge? Multilateralism Under Challenge? Power, Normative Structure and World Order. E. Newman, R. C. Thakur and J. Tirman. Tokyo, United Nations University**:** 289-307.

Gupta, J. (2007). Developing Countries and the Post-Kyoto Regime: Breaking the Tragic Lock-In for a Waiting For Each Other Strategy. The Kyoto Protocol and Beyond: Legal and Policy Challenges of Climate Change. W. Douma, L. Massai and M.

Montini, TMC Asser Institute Press in association with Cambridge University Press.

Gupta, J. (2007). "Legal Steps Outside the Climate Convention: Litigation." Review of European Community and International Environmental Law **16**(1): 76-86.

Gupta, S. and P. M. Bhandari (1999). "An effective allocation criterion for CO2 emissions." Energy Policy **27**(12): 727-736.

Hale, T. N. and D. L. Mauzerall (2004). "Thinking Globally and Acting Locally: Can the Johannesburg Partnerships Coordinate Action on Sustainable Development?" Journal of Environment and Development **13**(3): 220-239.

Hargrave, T., N. Helme, et al. (1998). Growth Baselines. Washington, D.C., Center for Clean Air and Policy.

Hoff, H., K. Warner, et al. (2005). "The Role of Financial Services in Climate Adaptation in Developing Countries." Vierteljahrshefte zur Wirtschaftsforschung **74**(2): 196-207.

Hoffert, M. I., K. Caldeira, et al. (2002). "Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet." **298**(5595): 981-987.

Hoffmann, S. (2000). Clash of Globalizations. The Global Transformation Reader: An Introduction to the Globalization Debate. D. Held and A. McGrew. Cambridge, Polity Press**:** 106-111.

Höhne, N., M. d. Elzen, et al. (2006). "Common but differentiated convergence (CDC): a new conceptual approach to long-term climate policy " Climate Policy **6**(2): 181-199.

Höhne, N., D. Phylipsen, et al. (2005). Options for the second commitment period of the Kyoto Protocol. Berlin, Germany, Umweltbundesamt.

Huntington, H. G. and S. P. A. Brown (2004). "Energy security and global climate change mitigation." Energy Policy **32**(6): 715-718.

Jacoby, H. D., R. Schmalensee, et al. (1999). Toward a Useful Architecture for Climate Change Negotiations. Cambridge, MA, USA, MIT Joint Program on the Science and Policy of Global Change.

Jaeger, C. C. (2003). Climate change: combining mitigation and adaptation. Climate policy for the 21th century: meeting the long-term challenge of global warming. D. Michel. Washington, DC, Center fro Transatlantic Relations.

Kameyama, Y. (2003). Dual track approach : an optional climate architecture for beyond 2012. Tsukuba, Japan, National Institute for Environmental Studies.

Kemfert, C. (2004). "Climate coalitions and international trade: assessment of cooperation incentives by issue linkage." Energy Policy **32**(4): 455-465.

Kessels, J. R. and S. J. A. Bakker (2005). ESCAPE: Energy Security & Climate Policy Evaluation. Linking Climate Change and Energy Security Policy in Post-2012 Climate Strategies. Petten, Energy research Center of the Netherlands**:** 41.

Kim, Y. G. and K. A. Baumert (2002). Reducing Uncertainty Through Dual-Intensity Targets. Building on the Kyoto Protocol: Options for Protecting the Climate. K. A. Baumert, O. Blanchard, S. Llosa and J. F. Perkaus. Washington, D.C., USA, World Resources Institute**:** 109-133.

Kverndokk, S., K. E. Rosendahl, et al. (2004). "Climate Policies and Induced Technological Change: Which to Choose, the Carrot or the Stick?" Environmental and Resource Economics **27**(1): 21-41.

Lee, C.-C. and C.-P. Chang (2007). "Energy consumption and GDP revisited: A panel analysis of developed and developing countries." Energy Economics **29**(6): 1206-1223.

Lindmark, M. (2004). "Patterns of historical CO2 intensity transitions among high and low-income countries." Explorations in Economic History **41**(4): 426-447.

Lovins, A. and L. H. Lovins (1982). Brittle Power: Energy Strategy for National Security. Andovar, Mass., USA, Brick House Publishing Co., Inc.

McKibbin, W. J. and P. J. Wilcoxen (2002). Climate Change after Kyoto: A Blueprint for a Realistic Approach. Washington, D.C., USA, Brookings Institution Press.

METI (2003). Perspectives and Actions to Construct a Future Sustainable Framework on Climate Change, Interim Report by Global Environmental Subcommittee, Environmental Committee, and Industrial Structure Council, METI.

Meyer, A. (1998). The Kyoto Protocol and the Emergence of "Contraction and Convergence" as a Framework for an International Political Solution to Greenhouse Gas Emissions Abatement. Man-Made Climate Change: Economic Aspects and Policy Options. O. Hohmeyer and K. Rennings. Heidelberg, Germany, Physica-Verlag**:** 291.

Michaelowa, A., S. Butzengeiger, et al. (2005). Graduation and Deepening: An Ambitious Post-2012 Climate Policy Scenario. International Environmental Agreements: Politics, Law and Economics. **5:** 25-46.

Michaelowa, A. and K. Michaelowa (2007). "Climate or development: is ODA diverted from its original purpose?" Climatic Change **84**(1): 5-21.

Müller, B. (2001). Fair Compromise in a Morally Complex World: The Allocation of Greenhouse Gas Emission Permits Between Industrialised and Developing Countries. Oxford, UK, Oxford Institute for Energy Studies.

Müller, B. (2002). An FCCC Impact Response Instrument as part of a Balanced Global Climate Change Regime. Oxford, UK, Oxford Institute for Energy Studies.

Müller, B. (2003). Framing Future Commitments: A Pilot Study on the Evolution of the UNFCCC Greenhouse Gas Mitigation Regime. Oxford, Oxford Institute for Energy Studies.

Munich_Re (2005). Annual Review: Natural Catastrophes 2004. Munich, Munich Re.

Newman, E., R. C. Thakur, et al. (2006). Multilateralism Under Challenge? Power, Normative Structure and World Order. Tokyo, United Nations University.

Ninomiya, Y. (2003). Prospect for energy efficiency improvement through an international agreement. Climate Regime Beyond 2012 "Incentives for Global Participation". NIES/IGES. Tsukuba/Hayama, Japan, National Institute for Environmental Studies (NIES)/Institute for Global Environmental Strategies (IGES)**:** 16-19.

Nordhaus, W. D. (2005). Life After Kyoto: Alternative Approaches to Global Warming Policies, Yale University/NBER.

Nye, J. S., Jr. (2000). Globalization and American Power. The Global Transformation Reader: An Introduction to the Globalization Debate. D. Held and A. McGrew. Cambridge, Polity Press**:** 112-115.

Ott, H. E., H. Winkler, et al. (2004). South-North dialogue on equity in the greenhouse: A proposal for an adequate and equitable global climate agreement. Eschborn, Germany, GTZ GmbH.

Pan, J. (2005). Meeting Human Development Goals with Low Emissions : An Alternative to Emissions Caps for post-Kyoto from a Developing Country Perspective. International Environmental Agreements: Politics, Law and Economics. **5:** 89-104.

Peck, S. and T. Teisberg (2003). Securitizing the environment: a property rights approach to managing climate change. Risk and uncertainty in environmental and natural resource economics. J. Wesseler, H.-P. Weikard and R. Weaver. Cheltenham, Edward Elgar.

Philibert, C. and J. Pershing (2001). "Considering the options: climate targets for all countries." Climate Policy **1**(2): 211-227.

Pizer, W. A. (2005). "The case for intensity targets." Climate Policy **5**(4): 455-462.

Reinstein, R. A. (2004). "A Possible Way Forward on Climate Change." Mitigation and Adaptation Strategies for Global Change **9**(3): 245-309.

Schelling, T. C. (1997). "The cost of combating global warming: Facing the tradeoffs." Foreign Affairs **76**(6): 8.

Schelling, T. C. (2002). "What Makes Greenhouse Sense?" Foreign Affairs **81**(3): 2.

Schmalensee, R. (1996). Greenhouse policy architecture and institutions. Cambridge, MA., MIT Joint Program on the Science and Policy of Climate Change.

Schmidt, J., N. Helme, et al. (2006). Sector-based approach to the post-2012 climate change policy architecture. Washington, DC, Center for Clean Air Policy**:** 33.

SEPA (2002). Kyoto and beyond, issues and options in the global response to climate change Stockholm, Naturvårdsverket.

Sijm, J., J. Jansen, et al. (2001). "Differentiation of mitigation commitments: the multi-sector convergence approach." Climate Policy **1**(4): 481-497.

Stavins, R. (2004). Can an Effective Global Climate Treaty be Based on Sound Science, Rational Economics, and Pragmatic Politics? Cambridge, MA/Washington, D.C., USA, John F. Kennedy School of Government/Resources for the Future.

Stewart, R. B. and J. B. Wiener (2003). Reconstructing Climate Policy: Beyond Kyoto. Washington, D.C., USA, The AEI Press.

Sugiyama, T. and J. Sinton (2005). Orchestra of Treaties: A Future Climate Regime Scenario with Multiple Treaties among Like-minded Countries. International Environmental Agreements: Politics, Law and Economics. **5:** 65-88.

Tangen, K. and H. Hasselknippe (2005). Converging Markets. International Environmental Agreements: Politics, Law and Economics. **5:** 47-64.

Tinbergen, J. (1952). On the Theory of Economic Policy. Amsterdam, North-Holland.

Tol, R. S. J. (2002). "Estimates of the Damage Costs of Climate Change, Part II. Dynamic Estimates." Environmental and Resource Economics **21**(2): 135-160.

Tol, R. S. J. (2002). "Estimates of the Damage Costs of Climate Change. Part 1: Benchmark Estimates." Environmental and Resource Economics **21**(1): 47-73.

Tol, R. S. J. (2005). "Adaptation and mitigation: trade-offs in substance and methods." Environmental Science & Policy **8**(6): 572-578.

Tol, R. S. J., K. L. Ebi, et al. (2007). "Infectious disease, development, and climate change: a scenario analysis." Environment and Development Economics **12**(5): 687-706.

Tol, R. S. J. and R. Verheyen (2004). "State responsibility and compensation for climate change damages--a legal and economic assessment." Energy Policy **32**(9): 1109-1130.

Torvanger, A., G. Bang, et al. (2005). Broadening the climate regime: Design and feasibility of multi-stage climate agreements. Oslo, Norway, Center for International Climate and Environmental Research.

Vattenfall (2006). Curbing climate change: An outline of a framework leading to a low carbon emitting society. Stockholm, Sweden, Vattenfall.

Victor, D. G. (2003). International agreements and the struggle to tame carbon. Global Climate Change: The Science, Economics and Politics. J. M. Griffin. Cheltenham, Edward Elgar**:** 204-229.

Weitzman, M. L. (2007). "A Review of The Stern Review on the Economics of Climate Change " Journal of Economic Literature **45**(3): 703-724.

Wicke, L. (2005). Beyond Kyoto - A New Global Climate Certificate System. Heidelberg, Germany, Springer Verlag.

Winkler, H., B. Brouns, et al. (2006). "Future mitigation commitments: differentiating among non-Annex I countries." Climate Policy **5**(5): 469-486.

Wittneben, B., A. Haxeltine, et al. (2005). A framework for assessing the political economy of post-2012 global climate regime. Norwich, UK, Tyndall Centre for Climate Change Research.